TATA ENERGY RESEARCH INSTITUTE
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"FINAL"

VOLUME - II

DETAILED ENERGY AUDIT REPORT

ON

CITY DISTRIBUTORY PUMPING STATIONS

AT

BANGALORE WATER SUPPLY & SEWERAGE BOARD
BANGALORE

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DETAILED ENERGY AUDIT OF CITY DISTRIBUTORY PUMPING STATIONS

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1.0 INTRODUCTION

1.1 TERI was assigned with energy audit study of all the major pumping stations including city distributories

The 'draft report' pertaining to the detailed energy audit was prepared in two volumes. Volume-I covering main pumping stations of Cauvery/Arkavathy Zone has been submitted to BWSSB for their comments and suggestions to enable to finalise the report. Subsequent to the discussions with Board officials final report is prepared The present Volume II covers detailed audit report of city distributory pumping stations.

A team of four consulting engineers from TERI were involved in the energy audit study. During the survey, all the installations were visited and studied in detail and every attempt was made to understand the operational and technical feature of each installation Detailed measurements were taken wherever necessary/possible using TERI instruments and collected the required data.

A Data Collection

This included pumping station details like.

- ⇔ Power supply inputs and electrical data
- ⇔ Pumps and motors
- ⇔ Capacitor banks
- ⇔ Water supply input and output details
- ⇔ Operating parameters of the station
- ⇔ Throttling of valves

In few of the distributory stations the pipe lines were embedded in the ground and hence flow measurements were not possible.

b. *Trial Runs/Tests*

Trial runs / tests were conducted at each installation to assess efficiency figures applicable for motor-pump sets.

c. *Hydraulic kW required and Combined Efficiency*

The hydraulic kW required to raise the required quantity of water to assigned head and combined efficiency of pump-motor was evaluated.

d. *Data Analysis*

The data collected, measurements taken and test carried out have been used in the analysis. The various factors considered for analysis are generally as follows:

- Operating load
- System efficiency

This analysis helped in identifying

- Sizing adequacy of motor with regard to pump capacity/head (Loading pattern)
- Efficiency parameter analysis
- Power factor improvement

1.3 OBSERVATION AND ANALYSIS

Following paragraphs furnished the details of the observation made on the distributory pumping stations and observation made on the distributor pumping stations and analysis of them in a nut shell.

A. Operating Loads

The following table furnishes the names of pump houses with installed capacity, standby details and operating load details.

Pump House No	Name of the Pumping Station	Installed Capacity	Standby Details	Operating Loads (HP)
1	Highground			
2	Pump House - I	3x250 HP	1 stand by	2X250
3	Pump House - II	4x100 HP	1 stand by	3 X 100
4	Miller Road	1x60 HP 1x50 HP	1 stand by	1 X60
5	LLR Pump House - I	3x100 HP	1 stand by	2 X100
	Pump House - II	2x50 HP	All run	2 X 50
6	Hosahalli	1 x 250HP + 2 x 240 HP	1 stand by	2 X 250
7	Magadi Road (overhead tank)	2 x 50 HP	1 stand by	1 X 50
8	West of Chord Rd.(overhead tank)	2 x 50 HP	1 stand by	1 X 50
9	Banashankari	2 x 60 HP	1 stand by	1 X 60
		2x100 HP	1 stand by	1 X 100
		1x150 HP	Extra	
10	Mount Joy	3 x 50 HP	1 stand by	2 x 50
11	Basavangudi	2x60 HP	not in use	Booster Pump
12	Indiranagar(overhead tank)	2x40 HP	1 stand by	1 X 40
13	Koramangala (overhead tank)	2 x 50 HP	1 standby	1 X 50
14	Ulsoor	2x75 HP	1 stand by	1 X 75
15	Banappa park (overhead tank)	2 X 50 HP	1 stand by	1 X 50

Pump House No	Name of the Pumping Station	Installed Capacity	Standby Details	Operating Loads (HP)
16	Domlur (overhead tank)	1x50 HP	-	1 X 50
17	HAL Aeroengine - I	2x90 HP	1 stand by	1 X 90
18	OMBR, Machalibetta	4x100 HP	2 stand by	2 X 100
19	ITI, Machalibetta	2x50 HP	1 stand by	1 X 50
20	Chikkalalbagh	1x60 HP		1 X 60
21	Jayanagar Market Complex (Overhead tank)	1x50 HP 1x75 HP	1 stand by	1 X 75
	Johnson market			
22	Pump House - I	2 x 90 HP	1 stand by	1 X 90
23	Pump House - II	2 x 90 HP	1 stand by	1 X 90
24	Malleswaram (CJF)	4x150 HP + 1 X 85 HP + 2 X 60 HP	Two not running 1x150+1x170	3 X 150 + 1 X 85 + 2 x 60
25	Tata Institute (Malleswaram)	2x50 HP	1 stand by	1 X 50
26	BEL Pump house (Malleswaram)	2x50 HP	1 stand by	1 X 50
27	Yelahanka (Malleswaram)	3x100 HP	1 stand by	2 X 100
28	Old Machibetta (Malleswaram)	2x50 HP	1 stand by	1 X 50
29	Malleswaram office complex and filling point	1x25 HP	-	1 X 25
30	HGR & KGT Pump house (Malleswaram)	2x150 HP	-	2 X 150
31	Jayanagar T Block (Overhead tank)	1 X 50 HP 1 X 25 HP		1 X 50 1 X 25
32	K.G.Tower	2 X 40 HP	Not running	-
33	Vijayanagar	2 x 50	1 standby	1 x 50
34	OHP	2 X 50	1 standby	1 x 75
35	Yelahanka	2 x 75 HP	1 standby	1 x 75
Total of 35 Stations		7270 HP (84 Nos.)	2875	4395 HP (49 Nos)

Out of 35 distributory stations, 28 nos. of pumping stations feed directly to the consumer areas and 7 nos. either fill over head tank or feed to distributory system directly. The total installed capacity of 35 pumping stations is 7270 HP, out of which 2875 HP capacity is built-in in the system as standby. The operating hours of each station vary dependant on the water storage/area of spread etc. All stations have 440 Volts motor with ratings and their nos. as follows

Sl No	Capacity of Motors	Nos.	Installed Pump Stations
i	250/240 HP	6	2
ii	150 HP	7	2
iii	100/90 HP	22	8
iv	75 HP/85 HP	6	3
v	60 HP	8	5
vi	50 HP	29	15
vii	40 HP	4	2
viii	25 HP	2	2
	Total	**84**	

B Energy Consumption Trends

The distributory stations energy consumption and power charges are as follows:

Year	Lakhs Units	Power Charges
1993-94	47.73	64.50
1994-95	39 96	64.77

C *Combined Efficiency of Pump - Motor*

For evaluation of efficiency of pump-motor, the flow of water from each pump has to be measured. In many of the pumping stations, flow is not possible in view of inadequacy of free length of pipe available flow for measurement. The method of calculation for combined efficiency of pump-motor is using the following formula:

The hydraulic power in kW = 9.81 QH

Where Q = flow in m^3/sec
H = head in mtrs

The electrical input in kW is also measured for the given head and discharge.

$$\text{Thus } \%\eta_{p\text{-}m} = \frac{\text{Hydraulic kW}}{\text{Actual kW}} \times 100$$

The combined efficiency of pumps in the stations, where pump work for 24 hours should have efficiency figures at least 70%. However in respect stations working up to 8 hours, the system efficiency is said to be reasonably good, if it is above 50%. In case of filling up over had tank task the pump efficiency figure is not very important in view of intermittent use of the pump.

The combined efficiency figures for pump-motor of the stations where flow measurements are possible are detailed below·

Name of the Station	Combined/ System Efficiency (%)	Remarks
Highground Station-II (4 X 100 HP)	55 (for manifold)	Satisfactory (Replacement of motor by high efficient proposed)
Miller Road	1 0	Very unsatisfactory
LLR Pump 1/2	47.8/52.67	Not satisfactory, since works for more than 12 hours
Magadi Road (Overhead tank)	50.8	satisfactory
West of Chord Road (Overhead tank)	48	No replacement action necessary
Banashankari	51 8/57.13	Very satisfactory
Mount Joy	51	Not Satisfactory-14 hours operation
Indiranagar (Overhead tank)	35.25 (throttled condition)	Satisfactory
Ulsoor	42 35	Replacement of pump necessary
Domlur	37.13	Replacement of pump necessary at later date
OMBR	64.18	Satisfactory
ITI	28 36	Replacement necessary
Johnson Market (CLR) Pump 1/2	62 7/50 4	Satisfactory
Malleswaram (CJF)	24.28	Replacement of pump necessary
Yelahanka (Malleswaram) Pump 2/3	76 84/51.62	Satisfactory
Old Machalibetta (Malleswaram)	64 19	Satisfactory
BEL Pump House (Malleswram	55 8	Satisfactory
HGR & KGT	69 22	Satisfactory

1.4 SUMMARY OF RECOMMENDATIONS

Based on the detailed analysis and observations the potential for energy saving was identified. Various energy conservation measures were arrived at to reduce the energy consumption and improve the efficiency The techno-economic feasibility to implement the measure was studied in detailed are given in the individual station report. The various measures arrived at are:

- ⇨ Review of contracted kVA demand and identifying of excess
- ⇨ Improvement of pf
- ⇨ Replacement of existing standard efficiency motor/pump by high efficiency motor/pump
- ⇨ Operating practice for pumps to achieve flexibility and changing to have increased flow.
- ⇨ Shifting of unused pumps to other area.
- ⇨ Improving metering system

The above summary of recommendation for various stations are listed below:

A *Review of contracted kVA demand and identifying of excess contracted kVA*

The existing kVA contract demand with KEB has been studied in details with requirement of stations based on connected load, expansion issue and simultaneous running of pumps The following table furnishes the details of stations of possibility of surrendering excess kVA.

Sl. No	Pumping Station	kVA		Expected max loading at the station	Excess demand identified	Annual Savings
		Contracted	75%	kVA	kVA/month	Rs. (lakhs)
i	Highground	900	675	600	115	1 38
ii	OMBR	250	188	115	165	1 02
Total					200	2 40

This measure will account for saving of 200 kVA/month in demand equivalent of Rs. 2.40 lakhs annually.

B Improvement of pf.

The operating power factor of 5 motors have been noticed to be less than 0 9 at the bus level. Some of the existing capacitor banks are in operative due to various reasons. This is also covered under the reports. It is estimated that with the improved pf 167 kVA, costing Rs. 2.0 Lakhs can be saved. A summary of savings pumping station-wise is given below.

Sl. No	Pumping Station	Demand Savings			Investment	Simple payback period
		kVA	Rs per month	Rs (lakhs)/yr	Rs	years
i	Highground (4X100HP)	47	4700	0.56	Existing capacitor bank to be repaired	Immediate
ii	LLR (3X100HP)	23	7,000	0 27	12,000	5 Months
iii	Hosahalli Motor No.1 (250 HP)	70	300	0 36	Existing capacitor bank to be repaired	Immediate
iv	OMBR	3		0 47	4,500	1 year 3 months
v	BEL Pump House Malleswaram	3	3000	.036	1800	6 months
vi	Yelahanka Pump House	4	400	.048	2400	6 months
vii	HGR & KGT	17	1700	0 20	10,500	6 months
	Total	167	16700	2.00	31200	

C Replacement of existing standard efficiency motor/pumps by high efficiency motor/pump.

This is based on the following criteria

- the motor-pump sets which works for 24 hours continuously
- If the motor-pump set is of more than 15 years old and efficiency is low (less than 50%) for 8 hours of operation.

The techno-economic feasibility of replacement of such sets will result in savings to the tune of 36.43 lakhs units annually costing Rs 72.03 lakhs.

Sl. No	Pumping Station	Annual Savings			Investment Rs. (lakhs)	Simple payback period years
		Demand kVA p.m	Energy kWh (lakhs)	Rs. (lakhs)		
I	Highground (4X100HP proposed replacement by 3X250 HP)	14.2	0.37	0.17+ 0 74 0.91	Board is taking action for replacement of 100HP to250HP *	2.7
ii	LLR (3X100HP)	-	3.72	7.44	9.0	1 25
iii	Mount Joy (3 X 50 HP)	-	1.2	2.5	4.5	Less than 2
iv	Ulsoor (2 X 75 HP)	-	0.70	1.4	4.2	3 years
v	ITI (2 X 50 HP)	-	1.31	1.51	3	2 0
vi	Malleswaram CJF (4X150HP)+1X85HP+ 2X60 HP	-	19.13	38.26	14.0	0 6
vii	Hosahalli (3X250HP)	-	10.0	20.00	6.00	
	Total	14.2	36.43	72.03	40.4	

* Board has proposed replacement action for procuring motor It has to be high efficincy pump

D Changing of operating practice for pumps to achieve flexibility to have increased flow:

i Highground/station:

III stage from Tataguni terminates at this station The existing pumps are directly connected to the 1750 mm main line. Any tripping of pumps either at Tataguni or at highground station affect the system. To overcome this, existing two nos. of storage tank of 9 MG and 3 MG could be utilised, to these tanks first and then pumping station to draw from them This will give required flexibility of operation of both station. North zone of Bangalore is dependent on efficient operation of highground, this measured has to be considered immediately for implementation.

Further this will also ensure improvement of the water flow from the pumps. Similarly in case of LLR, examination for improved pumping system has to be made, so that Malleswaram area gets additional water through LLR also. These issues have been already covered while discussing individual stations. The actual quantification of benefits from these measures is difficult.

ii Malleswaram CJF:

There are 6 storage tanks with 37 MG capacity. These tanks receive water from different sources including Cauvery Zone and Arkavathy Zone. There are 6 sets of different of pumping stations for feeding to distributory area (overhead tanks). It would be necessary to have inter-connection pipe networking to connect these tanks, so that water from any tank to any pumping station is possible. As a next step optimisation of existing pumping systems will be able to take care of 2 distributory areas instead of dedicated station to the dedicated area. Thus pumps could be utilised for more number of hours instead of having many no of pumps This also help in containing maximum demand on the station Before making final decision, a small committee of officers of Board can examine the various options possible, in view of the complexities of network developed and then opt for the best solution taking into consideration of future expansion plans.

Repairs on one of the tank, of 3 5 MG has to be taken up immediately to have full storage at Malleswaram. Quantification of benefits from the above measures is difficult and hence not done.

iii. Hosahalli

The existing dual head pump should be used only for higher pressure of 5.8 kg/cm^2, where feeding to Rajajinagar area and new pump of pressure 3 kg/cm^2 should be used to feed Hosahalli area. This measure is expected to save energy to the tune of 15% of the existing level.

Further the pressure and flow pattern for this pump house varies largely due to incoming line has much tappings. The working of station could be improved, if a ground level reservoir is proposed at the inlet of the pumping station. This measure will give flexibility in operation also.

E Shifting of pumps-motor set identified as excess and not presently utilised

			Capacity
i.	Banashanskari	=	150 HP
ii.	Malleswaram (CJF)	=	170 HP
iii.	Chikkalalbaugh	=	50 HP

F Improving Metering System

Metering plays a vital role in any system for better management of energy it helps in monitoring and controlling of various parameters involved in the operation The various parameters to be monitored and controlled in water supply are·

Location	H T Installation	L T Installation
Electrical	kVA demand	-
	Energy consumption	Energy consumption
	Power Factor	Power Factor
	Time totaliser across pumps	
Water side	Pressures	Same as in case of i
	Flow measurement	
	Totaliser of water for individual pumps/mains	

All measurements should be recorded hourly and review daily/weekly to be made for deviation.

It is strongly recommended for nodal stations all there measuring meters are installed immediately, so that water auditing could be done by BWSSB staff and specific energy consumption figures could be monitored continuously The following stations could be considered as 'nodal' stations

a High ground Station I & II
b LLR Station
c Malleswaram Stations - HGR, KGT, GJF, Yelahanka
d IMBR Stations I & II
e Mount Joy Station
f Hosahalli Station

5.0 POTENTIAL FOR ENERGY SAVINGS

The scope for energy conservation in BWSSB distributory has been studied and discussed in detail.

It is estimated that about 36.43 lakhs units amounting to Rs. 76.43 lakhs can be saved by implementing various measured recommended. The following table gives the summary of the various measures suggested.

Sl. No	Measure	Annual Savings		Cost of Savings	Investment Required	Simple payback
		kVA Demand	Energy (Lakhs)	Rs. (lakhs)	Rs. (lakhs)	period (Years)
a	Review of contracted kVA demand and identifying excess	200	-	2.40	NIL	NIL
b	Improvement of pf	154	0.85	1 1	9 18	Within 2 months
c	Replacement of existing standard efficient motor/pump by high efficiency motor/pump	14.2	36.01	72.03	40.4	< 2
d	Changing operating practices to achieve flexibility to have increased flow	Quantification is not Possible				
e	Improving metering system	Quantification is not Possible				
	Total	368	36 86	75.53	49 18	< 2

It can be observed that the maximum simple payback period worked out is less than 2 years.

1.6 CONCLUSION

TERI is thankful to Sri.Govindappa TM(Rtd.) KEB for his valuable guidance during energy audit and analysis. We also wish to place on record our thanks to Mr.C.D.Sukumar -AEE(Co-ordinator), other station staff of BWSSB and also Sri Sharma-BWSSB , Van driver for their co-operation extended to TERI team during the study period

2.00 HIGH GROUND PUMPING STATION

2.1 FACILITY DESCRIPTION

This pumping station receives water from Tataguni Third Stage through 1750mm main. Out of various distribution stations within the city, this station has very prime importance in view of nodal position connecting to CJF, Malleswaram on Northern zone and tapping from main pipe to OMBR on the eastern side. This station is thus acting like a "signal director" for the further flow of 60 MGD water received from Tataguni stage-III.

There are two reservoirs one of 9 MG and another of 3 5 MG at highground. 3 X 250HP pumping station feeds to 14 MG tank of Malleswaram and 4 X 100HP to 3.5 MG tank at Malleswaram/KG tower

The water is pumped directly to Malleswaram storage tanks There are two pumping stations one with 3 X 250 HP capacity and another with 4 X 100 HP pumps Normally 2 X 250 HP and 3 Nos X 100HP motors operate continuously. Board has initiated to replace 3 X 100HP motors to 2 X 250HP In addition, to this there is a separate pumping station on Miller Road feeding directly to Shivajinagar area. The details of Miller Road Pumping Station is discussed as a separate chapter.

2.2 PUMP HOUSE NO.1 (3 X 250 HP)

Equipment Details

A. Pumps

Particulars	Pump # 1 to 3
Pump make	Mather + Platt
Discharge	1498.8 m^3/h
Head, /m	30
Speed rpm	1480
Type	12/14 BLE

B. Motors

Particulars	Motor # 1 to 3
Make	NGEF
Frame	AJ315M4
Insulation class	B
Voltage, V	415
rpm	1475
Amps	346
kW/HP	185/250
P.F.	0 8
Protection, Duty	IP23 ,S1
Serial No.	176-134-00
Auto-trfr startup position	70% tap
Capacitor	200 kVAr

2.3 PUMP HOUSE NO.2 (4 X 100HP)

A. Pumps

Particulars	Pump # 1 to 4
Pump make	Kirloskar
Discharge	195 lps
Head, /m	30
Speed rpm	1460
Type	10UPS2

B. Motors

Particulars	Motor # 1 to 4
Make	Kirloskar
Frame	LC 250 S
Insulation class	B
Voltage, V	415
rpm	1475
Amps	129
HP/kW	100/75
P.F.	0.8
Protection, Duty	IP23 ,S1
Serial No.	2830405-1
Auto-trfr startup position	70% tap
Capacitor	2 x 100 kVAr

2.4 OBSERVATION, ANALYSIS AND FINDINGS

A) Pump Parameters

➢ *Pump House No 1 (3 X 250 HP)*

i The flow measurements were not possible in view of the suitable free length of pipe on the discharge line being not readily available.

ii There are three pumps of 250HP out of which two are main and one is standby. The standby pump comes into operation by cyclic rotation basis

iii Manifold pressure is maintained at 2 kg which feeds to Malleswaram

iv The inlet valves of pump no.1 and 3 are leaky.

Pump House No. 2 (4 X 100 HP)

The flow measurements were not possible in view of the suitable free length of pipe on the discharge line is not readily available but the manifold measurements have been taken. The combined efficiency of manifold is derived at 55% which is satisfactory.

ii There are four pumps of 100HP out of which three are main and one is standby. The standby pump comes into operation by cyclic rotation basis.

iii Manifold pressure is maintained at 2 kg which feeds to Malleswaram

iv Main outlet Butterfly valve is throttled by 30%. However, BWSSB can check-up the flow and pressure pattern by opening the valve fully and possible energy savings for higher flow in the manifold could be checked

B Loading Parameters

- *Pumping House No 1 (3 X 250 HP Motors)*

Pump-Motor No	VL	IL Amp	Rated kW	kW	PF	RPM	Hs m	Hd m	Vel m/s	Area m^2	Qcal m^3/h	Q m^3/h	Th. kW	% Load	% Comb eff.	Remarks
1	368.5	252	180	157.5	0 8	1421 (1475)	NP	NP	NP	NP	NP	NP	NP	87.5	NP	The present capacitor banks of 2 sets of each 100 kVAr which was across the busbar is not connected due to cable fault
2	372	244	180	137	0.85	1415 (1470)	NP	NP	NP	NP	NP	NP	NP	76.11	NP	Motor No 1 has large unbalance current of 7% indicating if it is a rewound motor The starting contactor of this motor is with chattering noise and requires immediate attention Typical starting current is 926 A
3	366.8	271	185	143.8	0.83	1417 (1470)		NP	NP	NP	NP	NP	NP	77.29	NP	
Total			545	438 3				20						80.42		

Thus the loading pattern of all the three pumps are satisfactory

- *Pumping House No 2 (4 X 100 HP Motors)*

Pump No	VL	IL Amp	Rated kW	kW	PF	Hz	RPM	Hs m	Hd m	Vel m/s	Area m^2	Qcal m^3/h	Th. kW	% Load	% Comb eff.	Remarks
1	391	113 2	75	66	0.9	4 7	(1388) (1460)	NP	NP	NP	NP	NP	NP	88.4	NP	100 kVAr capacitor bank is connected to LT bus
2	388	111 6	75	70	0 9	47.9	1402 (1460)	NP	NP	NP	NP	NP	NP	93.73	NP	
3	Not in operation due to rubber coupling replacement															
4	368	105	75	62	0 9	47.9	(1398) 1460	NP	NP	NP	NP	NP	NP	82 00	NP	
Manifold				198				2	28	2 2	0.196	1538	109.02	80.42	55.03	

C *Electrical System*

i 11 kV grid is tapped for the pumping station by having H T installation of 1000 kVA 11/0.433 kV transformer.

ii The contract demand is 900 kVA and 75% of contract demand works out to 675 kVA which is presently billing demand.

iii The maximum and minimum demand in a year is in the range of 388-290 kVA as against billing demand of 675 kVA (287 kVA higher).

iv The kVA demand and unit consumed for the station 1 and 2 together are tabulated below

Month	kVA Demand	Units Consumed in lakh kWh
Jan 96	317	1.62
Feb	331	1.59
Mar	295	1.48
Apr	-	1 56
May	310	1.65
June	388	1.77
July	301	1.61
Aug	340	1.78
Sep	328	1.72
Oct	316	1.69
Nov	323	1.78
Dec	308	1.67
Jan	303	1.62

v With the present simultaneous working of motors i.e.(2X250HP) + (3 X 100HP) = 700 kVA demand is expected with 80% loading this will have to be around 600 kVA as against 388 kVA recorded, due to possible error in the KEB H.T metering cubicle, though motors are loaded for 80% level.

vi. Board is contemplating to install 2 X 250 HP in place of existing 4X100 HP. Thus demand will go up by 100 kVA i.e. presently the maximum demand is 330 kVA. This figure will be up by another 100 kVA i.e.430 Hence it is possible to surrender excess demand once the new pumps are replaced, KEB meter calibration and exact surplus is identified. With the demand savings envisaged is atleast 115 kVA / month, this amounts to Rs.11,500/- per month (Rs.1.38 lakh per annum).

D *Analysis of Electrical Parameters*

a *For Station - I (3 X 250 HP)*

i The present loading of the station is 438 kW as against the installed capacity of 545 kW which is about 80% which is good loading on the system.

ii The operating power factor of the bus level of station - I is 0 82 - 0 85. The power factor has to be improved to 0.9 with the installation of capacitors at the bus

The present capacitor bank of 2 X 100 kVAr which is disconnected due to cable fault is to be put into service. With 1 X 100 kVAr capacitor bank addition The demand savings of 47 kVA per month will be achieved amounting to Rs.84,000/- per annum. The distribution loss savings has not been considered in view of shorter length of cables.

iii Motor no 1 has large unbalanced current of 7% indicating that the motor is rewound and also accounts for higher losses.

iv The existing motors are of standard efficiency motors which are designed for voltage variation of +/- 6% and frequency +/- 3%. The class of insulation is B and the full load efficiency is 92.0% and power factor is 0.8 Presently, energy efficient motors with full load efficiency of 95% and power factor 0.88 with Class F insulation is available. Moreover, the motors are designed to operate at voltage and frequency variations of +/- 10% and +/-5% respectively. The energy and demand savings that can be achieved with replacement of existing motors is 37085 kWh/year and 14 2 kVA amounting to Rs.90,000/- Details furnished below:

Replacement of Nominal Standard Efficient Motor by High Efficiency Motor

Input Data

Capacity of Motor = 185.00 kW
Efficiency of a standard motors = 0 92
Efficiency of a high efficiency motors = 0.95
Power factor of STD Motor = 0 88
Power Factor of High Efficiency Motor = 0 90
Energy Rate (Rs. Per unit) = 2.00
Maximum Demand Rate (Rs./kVA)Month = 100
Operating Hours per year = 5840
Cost of STD Motor in Rs. = 2.0 lakhs
Cost of high efficiency motor in Rs. = 2.5 lakhs

vii) The starting contactor in the motor starter of motor no.1 is with chattering noise and requires immediate attention.

b. *For Station II (4 X 100 HP)*

i The present loading of the station is 198 kW as against the installed capacity of 225 kW which is about 88% which is good loading on the motor.

ii The operating power factor of the bus level is 0.88 - 0.91. The present capacitor bank of 100 kVAr is connected across the motor terminals to improve the operating power factor.

iii. The existing motors are of standard efficiency motors which are designed for voltage variation of +/- 6% and frequency +/- 3%. The class of insulation is B and the full load efficiency is 88 0% and power factor is 0.8. Presently, energy efficient motors with full load efficiency of 93.5% and power factor 0.88 with Class F insulation is available. Moreover, the motors are designed to operate at voltage and frequency variations of ± 10% and ± 5% respectively. Board already contemplating to install 250 HP motor in place of these 100 HP motors. While selecting the pumps it should be necessary to select high efficient pump to have 93.5% efficiency level The energy and demand savings that can be achieved by opting to high efficient pumps is 37,085 kWh/year and 14 kVA amounting to Rs.90,000/-.

iv Pump No. 3 is not in working condition due absence of rubber coupling.

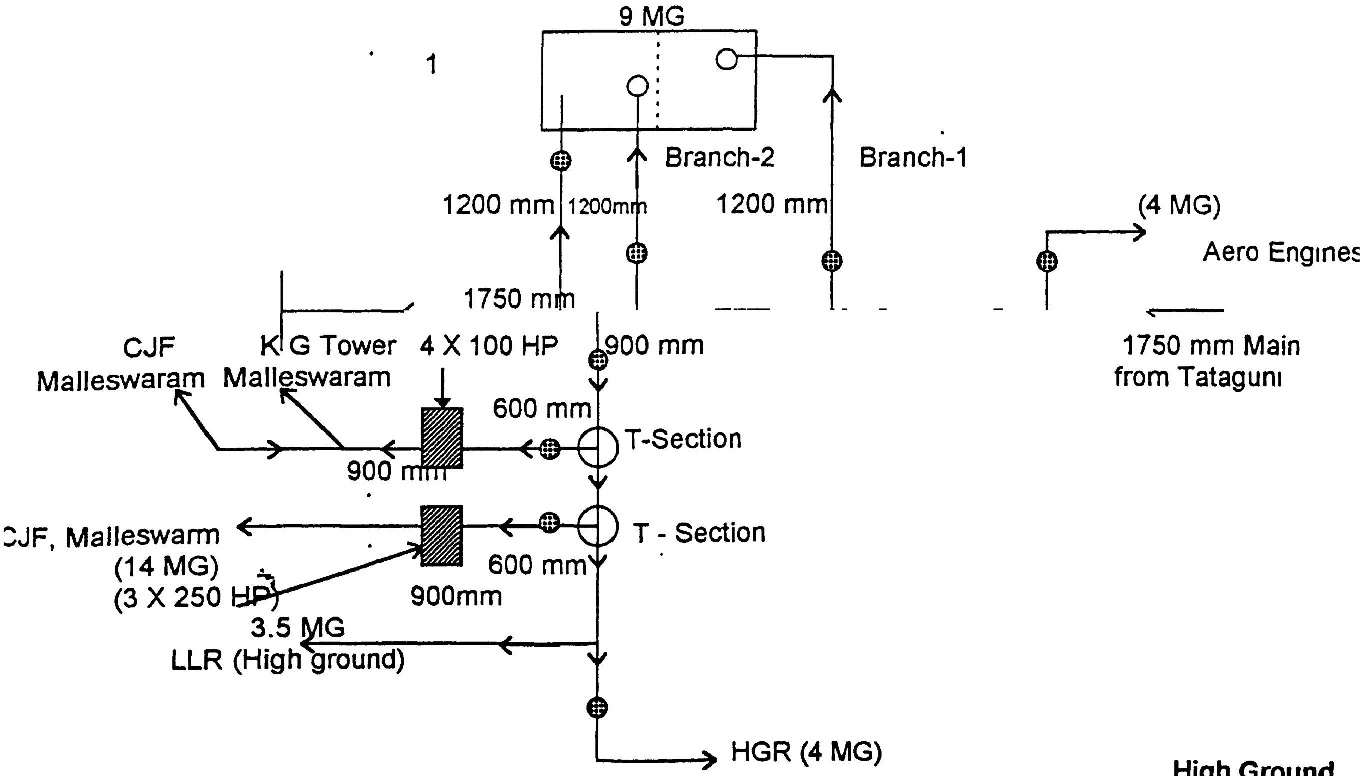
v The starter panels physical locations do not tally with the physical location of pumps thereby causing lot of confusion for the operators. This should be rectified at the earliest opportunity.

E. Flow Pattern Analysis:

The Stage III pipe line of 1750 mm terminates/branches office at Highground station. The pumping from Tataguni III stage is of the order of 60 MGD Presently this station pumps draw water directly from the 1750 mm mains through 900 mm tap pipe. The piping configuration at Highground stations are as follows:

i. 1750 mm main pipe from Tataguni
ii. 2 Nos. of 1200 mm branch to 9 MG storage reservoir.
iii. Main branch office by 900 mm pipe to pump station I & II and also to 4 MG or HGR tank.
iv. Pump House-I (3 X 250 HP) feeds to CJF Malleswaram (14 MG)
v. Pump House-II (4 X 100 HP) feeds to CJF/KG Tower
vi. 1750 mm mains has a tap off to Aero Engines 4 MG tank.

Single line diagram of the above is as follows:



High Ground

With the present rating of pumps, about 26 MGD of pumping capacity is available with 80-88% of loading pattern atleast 23 MGD or water flow is expected. However, it is learnt that presently pumps are driving up to 20 MGD of water (from the measurements of storage tanks at Malleswaram). At LLR 9 MGD pumping capacity is available. However water flow to Malleswaram via LLR is said to be 5 MGD. Any improvement of highground pumping station by way of :

- ⇨ additional pumps of higher size
- ⇨ providing higher sized inlet pipes to pumping station I & II
- ⇨ provision of smooth 90° bends for pumping station I & II inlet pipe which are presently with T-section
- ⇨ the main outgoing manifold butterfly valve of station (4 X 400 HP) is presently throttled. This could be opened and checked for flow and pressure pattern.

Will definitely allow more flow of water up to 26 MGD from highground station (in turn from stage-III)

It would also be necessary to review the present practice of directly drawing of water from the mains, as the flow is actually dependent on efficient operation of highground pumping station Any tripping of pumps at Highground or Tataguni the supply is affected To have more flexibility and smooth flow of water the Board can examine the implementation of the following measures.

- ⇨ To draw the water from 9 MG/4MG storage tank for these pumps at highground stations instead of directly drawing from the mains
- ⇨ To create extra pumping capacity at LLR to have improved flow up to 9 MGD to Malleswaram, transmission mains from LLR to Malleswaram is adequately sized.

2.4 RECOMMENDATIONS

A. Review of contracted Demand and Identifying Excess.

Even with replacement of existing 100 HP pump by 250 HP, there is a excess kVA demand contract of KEB. This requires detailed examination of excess kVA demand immediately after installation of new 250 HP pumps. This measure is expected to demand charges as follows·

Possible excess demand of kVA	.	115 kVA
Savings of demand		Rs. 11,500/- per month
Savings of demand per annum	:	Rs. 1.38 lakhs.

B Power Factor improvement for bus level of station-I (3 X 250 kVA)

In view of two part tariff for electricity the existing bus pf which 0 82 could be improved to 0 9 by re-installing disconnected capacitor banks of one bank of 100 kVAr. This measure is expected to demand savings as shown below

i.	Existing bus pf	: 0.82
ii.	Re-connection of capacitor banks (atleast 1 bank of 1000 kVAr)	: 1 X 100 kVAr
iii	Improvement in bus pf	: 0 90
iv.	Demand savings	: 47 kVA/month
v	Cost of demand savings	: Rs.4,700/ - per month (or) Rs.56,400/ per annum
vi.	Investment	: Nil (since disconnected capacitor banks to be put back with repairs)
vii.	Payback period	: Immediate

C. Replacement of existing Standard Efficient Motors (92%), of 250HP by High efficient motors (95%)

As these stations work for 24 hours continuously, improvement in efficiency by 3% for this capacity motors will account for energy savings as detailed below:

i.	Cost of high efficient motor	: Rs. 2.5 lakhs
ii.	Savings in demand kVA	: 14.20 per month
	in energy kWh	: 37,084 units/annum
iii.	Cost of savings per annum	: Rs. 17,045 /- (+) Rs. 74,168/- Rs. 91,213/-

D Change of Operating Practice for Pumps to achieve Flexibility and to achieve increased Flow

i. Present practice of drawing the water directly from the Mains of Tataguni-III Stage is to be discontinued and has to be regulated through storage reservoirs up to designed value of 26 MGD.

ii. Capacity of pumps motors at LLR could be enhanced to do so that increased water flow up to 9 MGD is available to Malleswaram as transmission Mains between LLR and Malleswaram has adequate capacity.

2.5 SUMMARY OF POTENTIAL SAVINGS

Sl. No	Measure	Annual Savings		Investment Required Rs. (Lakhs)	Simple Payback Period Years
		Energy	Cost Rs (Lakhs)		
i	Review of contract demand & identifying of excess	115 kVA	1.38	NIL	N.A
ii	Power Factor Improvement Station-I (3X250HP)	47 kVA p.m	0.56	NIL (Existing capacity to be repaired)	N.A
iii	Replacement of existing standard efficiency motor(92%) by high efficient motor(95%)	14 2 kVA/p.m 37,084 units/year	0 17 0 74 0 91	2.5	Board has taken replacement action. It has to be high efficient motor
iv	Change of operating practice for pumps to have flexibility and to achieve increased flow	Quantification not possible			

3.0 MILLER ROAD (HIGHGROUND)

3.1 FACILITY DESCRIPTION

This receives water from Highground Storage Tank and feeds to Shivajinagar area and also fills up overhead tank whenever required. There are two pumps but the name plate details are not available.

3.2 EQUIPMENT DETAILS

The name plate details are not available.

3.3 OBSERVATION, ANALYSIS AND FINDINGS

i The following table furnishes the loading of the motor discharge of pump and operating power factor of the motor the pump and operating power factor of the motor.

VL	IL Amp	Rated kW	kW	PF	Hz	RPM	Hs m	Hd m	Vel m/s	Area m^2	Qcal m^3/h	Q m^3/h	Th. kW	% Load	% Comb eff
365 03	72 5	60	41 75	0 88	47 8	1403	-3	20	1	0176	6 43	NP	40	87.5	0 97

ii From the loading pattern the motor appears to be rated at 60 HP

iii The power drawn is 41.75 kW from the main.

iii The velocity of the flow is only 0.1 m/s, requiring detailed investigation from the Board

3.4 RECOMMENDATIONS

Detailed investigation is required by BWSSB as the station main pipe flow measurment which is quite low.

4.0 LOW LEVEL RESERVOIR (LLR)

4.1 FACILITY DESCRIPTION

There are two pump houses at LLR. One has 3 X 100 HP motors and another has 2 X 50 HP motors. This pumping station receives water from 1750mm mains tap of Tataguni-Bangalore-III Stage. There is a 3.5 MG storage tank (14 feet depth). Water is pumped from Station - I to CJF Malleswaram which is connected by 27" main header. The normal running of pump house no.1 is from 14.00 hours to 9.00 hours (19 hours).

The second pump house feeds directly to distributory area of Kumara Park, Madhavanagar, Gandhinagar and Chicklalbagh. This pump house normally works from 23 00 hours to 14.00 hours (15 hours).

4.2 EQUIPMENT DETAILS

A. Pumps

Pump House No.	I	II
Pump	3 Nos.	2 Nos.
Capacity	75 kW	37 kW
Make	Kirloskar	NOT AVAILABLE
Discharge	155 lps	
Head	30 m	
Type	BUP2M	
No	8286016	

B. Motors

Pump House No.	I	II
No. of Motor	3 Nos.	2 Nos.
Capacity	75 kW	37 kW
Make	NGEF	Kirloskar
Voltage	415	420
Current	138	63
Pf	0.83	-
Speed rpm	1445	1450
Insulation Class	B	-
Serial No.	16401403	6353811
Type	AJ25054	TQ1

4.3 OBSERVATION, ANALYSIS AND FINDINGS

Pump House - I (3 X 100HP)

A. Pump Parameters

The following table gives the flow measurements made on 100 HP pumps which normally supplies to Malleswaram

Pump No	Hs m	Hd m	Vel m/s	Qcal m^3/h	Th. kW	Actual kW	% Comb eff.
2	2	20	2.15	548	26.89	56.24	47.81
3	2	20	2.35	600	29.44	55.9	52.67

ii The operating hours of this pump house is 19 hours and the system discharge efficiency of the motor-pump set is 47.81% and 52.67% respectively. Hence the existing sets may be replaced by high efficiency pumps and motors so that the combined efficiency is improved to 70%. With 19 hours running of pumps each day (presently alternate day), the energy saving for each pump set that can be achieved per set is 1.24 lakh unit/year amounting to Rs. 2.48 lakh/year. The investment being Rs. 3.0 lakhs. The simple payback period will be 1¼ year. For three motors, the saving could be 4.96 lakh units amounting to Rs.7.44 lakh with an investment of Rs. 9.0 lakh.

B *Electrical Parameters for Pump House I*

The following table gives the measured electrical parameters

Motor No	VL	IL Amp	Rated kW	Actual kW	PF	RPM	% Load
2	398	102.5	75	56.24	0.76	1406	75
3	398	101	75	55.9	0.78	1406	75

i. The pump loading at 75% which is satisfactory.

ii. The system power factor is 0.76 and has to be improved to atleast 0.90. This requires installation of 2 X 20 kVAr at the bus level, if two pumps run. The demand savings that can be achieved is 23 kVA/ month and leading to annual saving of Rs 0.27 lakhs, the investment to be made is Rs 12,000/- with a simple payback period of 5 months

iii. The existing motors should be replaced by high energy efficient motors. The details are given in earlier section of pump parameters.

Pump House No.II(2 X 50 HP)

C *Pump Parameters*

i. The flow measurements were not possible inspite of several attempts.

D *Electrical Parameters*

i. The following table gives the measured electrical parameters

Pump No	VL	IL Amp	Rated kW	kW	PF	Hz	RPM	RPM Rated	% Load
1	382.33	49.9	37	30.94	0.91	47.8	1411	1450	83.6
2	378.87	49.2	37	28.97	0.87	47.7	1400	1450	78.3

ii. The operating power factor and loading on motors is satisfactory.

4.4 RECOMMENDATIONS

Pump House No.1 (3 x 100 HP)

i Replacing the existing Pump-Motor Sets

The existing pump-motor sets should be replaced by high efficiency pump-motor sets which give an annual energy savings of 1.24 lakh kWh/year per set amounting to Rs. 2.48 lakhs / yr per set. The investment required per set is Rs. 3.0 lakhs and simple payback period is 1 year 3 months. There are 3 pumps, the saving would be 3.72 lakhs of unit per year costing Rs 7.44 lakhs with investment of Rs 9.00 lakhs

ii Power Factor Improvement

The existing operating power factor of 0.76 should be improved to 0 9 with installation of 2 X 20 kVAr capacitor bank for the mains This measure will envisage demand savings of 23 kVA per month and annual savings of amounting to Rs 27,000/-. The investment required is Rs 12,000/- and simple payback period is 5 months.

4.5 SUMMARY OF POTENTIAL SAVINGS

Measure	Annual energy savings		Investment reqd. Rs.lakh	Simple payback period year
	Lakh kWh	Cost lakh Rs.		
Replacing existing pump-motor sets (3 Nos.)	3 72	7.44	9 00	1¼ Year
Power Factor Improvement	23 kVA/p.m	0.27	0 12	5 months
Total	**23 kVA & 3.72 lakh units**	**7.71**	**9.12**	-

5.0 HOSAHALLI PUMP HOUSE

5.1 FACILITY DESCRIPTION

The water is received from Mount Joy through 24" pipeline. This pump house delivers to two areas namely

a) Hosahalli area at 3 kg/cm^2
b) First Block Rajajinagar at 5.8 kg/cm^2 on alternate days

There are three pumps out of which normally two are main pumps and one is standby and is run on cyclic rotation of 8 hours.

5.2 EQUIPMENT DETAILS

A. Pumps

Particulars	Pump # 1
Pump make	Beacon
Discharge	-
Head, /m	35/58
Speed rpm	-
Type	10LAA

B. Motors

Particulars	Motor # 1	Motor # 2	Motor # 3
Make	NGEF	Siemens	Siemens
Type	AJ315M4	1RA2246-4	2246
Insulation class	B	B	B
Voltage, V	415		
rpm	1475	1470	1415
Amps	346		
HP/kW	185/250	240/200	240/200
P.F.	0.8	0.88	0.88
Protection, Duty	IP23 ,S1		
Serial No.		LBO53875	EBO4703
Auto-trfr startup position	70% tap		
Capacitor	60 kVAr		

5.3 OBSERVATION, ANALYSIS AND FINDINGS

A. Pump Parameters

The flow measurements were not possible as adequate free pipe length was not available which is a pre-requisite for measurements with a ultra-sonic flow meter.

B Electrical Parameters

i The following table gives the electrical motor loading pattern

Motor No	VL	IL Amp	Rated kW	Actual kW	PF	Hz	RPM	% Load
1	435.96	338	200	157 9	0 64	47.7	1420 (1475)	78 95
2	Start-up panel sent for repair not working							
3	377 14	277	200	159	0 86	47 7	1415 (1470)	79.50

One of the capacitor bank is lying idle and has to be utilised.

ii. The operating pf is very low of motor # 1, this is due to removal of the eixsting capacitor tanks due to some fault. This has to be put into service immediately to improve the power factor and minimise the kVA demand. This measure will save about 70 kVA/month which amounts to Rs. 7,000/- month (i.e Rs. 84,000/- per annum).

iii The pumps are operating at two different pressures, one with 3 kg/cm^2 and the other at 5.8 kg/cm^2 on alternate days. This dual head pump operation accounts for loss of energy. The operating time of pumps is very high and hence it would be advantageous to have separate set of pumps of 3 kg/cm^2. The quantification of energy saving is not possible in view of the absence of performance curve (flow pattern). Based on the head parameters 15% of energy saving could be expected.

C *Flow Patterns*

The pessure and flow of water to this pumps varies much due to incoming line has may tappings. The working of the station could be improved if a ground level resevior is designed at the inlet of the pumping station. This measure will give flexibility of operation also.

5.4 RECOMMENDATION

Installing new pumps of 3 kg/cm2 pressure

The existing dual head pump should be used only for higher pressure of 5.8 kg/cm2 when feeding to Rajajinagar area and the new pump of pressure 3 kg/cm2 should be used to feed Hosahalli area This measure is expected to save energy to the tune of 15% of the existing level i.e. 10 lakh units/year. The investment required would be in the range of Rs.3.0 lakh per pump and the simple payback period would be less than 2 years ii *Power factor Improvement*

The existing capacitor bank of 100 kVAr should be repaired and put into service which will save 70 kVA/month amounting to Rs.84,000/-

Demand Savings = 70 kVA/month
Cost Savings = Rs.84,000/-
Investment Required = Nil

iii *Flow Pattern*

A provision for creation of ground level storage tank has to be made and built at the earliest to have operational flexibility.

5.5 SUMMARY OF POTENTIAL SAVINGS

Sl. No	Measure	Annual Savings		Investment Required Rs (Lakhs)	Simple Payback Period Years
		Energy	Cost Rs (Lakhs)		
I	Existing capacitor bank of 100 kVAr should be repaired	70 kVA/ month	84,000	Nil	Immediate

6.0 MAGADI ROAD STATION

6.1 FACILITY DESCRIPTION

This pump house receives water from Hosahalli pumping station. There is also a link from Bull Temple Road Reservoir via Chamrajpet. There is an underground tank of 15m X 6m X 3m which accommodates 2.7 lakh litres. There is an overhead tank which is filled from the pump 50 HP capacity. In addition to this there is a standby pump of capacity 50HP.

6.2 EQUIPMENT DETAILS

A. Pumps (2 X 50 HP)

Capacity	50 HP
Make	Beacon
Head	19.2/27.1
Speed rpm	1450
Input kW	38.1
Serial No.	8290949
Efficiency	79%
Size	8L1

B. Motors

Capacity	37 kW/50 hp
Make	Crompton Greaves
Voltage	415
Serial No.	ABC0213
Speed in rpm	1450
Insulation Class	B

6.3 OBSERVATION, ANALYSIS AND FINDINGS

A. Pump Parameters

i. The time taken to fill up the overhead tank of capacity 0.2 MG is 3 hours which is at a head of 18 m.

Pump No.	Total Head m	Water flow in m^3/s	Hydraulic kW required	Actual kW drawn	System Efficiency
50 HP	18	0.083	14.7	28.9	50.8%

ii. The pump is used intermittently to fill up the overhead tank and the system efficiency is found to be satisfactory.

B. Electrical Parameters

i The electrical parameters measured are tabulated as follows

Motor No	VL	IL Amp	Rated kW	Actual kW	PF	Hz	RPM	% Load
1	406 55		37	28 9	0 91	47 8	(1409) 1450	78 1

ii The operating power factor is satisfactory.

iii The loading on the motor is 78 1% which is also good

6.4 RECOMMENDATIONS

NIL

7.0 WEST OF CHORD ROAD

7.1 FACILITY DESCRIPTION

This station receives water from Thippagondanahalli alternatively from CJF, Malleshwaram. There is an overhead tank of capacity 0.2 MG which is normally filled up to 1.5 MG The filling is through either by 40 HP or 50 HP pump.

7.2 EQUIPMENT DETAILS

A. *Pumps*

Capacity	40 HP	50 HP
Make	Kirloskar	Details Not Available
Discharge	80 lps	
Head	30 m	
Size	175 x 175	
RPM	1450	

B. *Motors*

Capacity	40 HP	50 HP
Make	GEC	Details not available
Voltage	415 V	
Current	67	
Insulation	A	
RPM	1500	
Type	A137	
Serial No	7501005/08	

7.3 OBSERVATION, ANALYSIS & FINDINGS

A. *Pump Parameters*

1 The time taken to fill up the overhead tank of capacity 0.2 MG is 3 hours which is at a head of 12 m.

Pump No.	Total Head m	Water flow in m3/s	Hydraulic kW required	Actual kW drawn	System Efficiency
40 HP	18	0.083	14.7	30.62	48%

The pump is used intermittently to fill up the overhead tank and considering the application system efficiency is found to be satisfactory.

B. *Electrical Parameters*

i. The measured electrical parameters are tabulated as follows.

Motor No	VL	IL Amp	Rated kW	Actual kW	PF	Hz	RPM	% Load
1	Motor Burnt Out		37					
2	373.68	58.4	30	30 62	0.77	47.8	1422 (1500)	102.09

The operating power factor is 0.77 only, though a capacitor bank of 20 kVAr is connected. Any improvement in the power factor does not benefit the Board in the monthly energy bill since the installation is under the LT rating and the cable lengths are very small.

ii The areas around the motor is filled with water and the cables are submerged under water This requires immediate attention

7.4 RECOMMENDATIONS

i The cable routing should be improved and water drain arrangement should be immediately done

ii - Burnt out motor of 50 HP should be repaired and put into service at the earliest

8.0 BANASHANKARI

8.1 FACILITY DESCRIPTION

The pump house receives water from a storage tank of capacity 5 MG which is adjuscent to the pumping station and supplies the same to Jayanagar VII Block and Banashankari areas. There are five pumps of 2 X 60 hp , 2 x 100 hp and 1 X 150 hp. The 60 hp pump feeds to Jayanagar VII Block and 100 hp pump feeds to Banashankari areas. The 150 hp pump is idle. The operating hours of the pump feeding to Jayanagar VII Block is 18 hours and that feeding to Banashankari is 12 hours

8.2 EQUIPMENT DETAILS

A. Pumps

Particulars	Pump # 1 & 2	Pump 3 & 4	Pump 5
Pump make	Mather + Platt	Mather + Platt	
Discharge	37 8 m3/h	46 8m3/h	159.1/219 7/87 lps
Head, m	38	20	47.8/34.2/52.1
Speed rpm	1480	1480	1450
Type	618 BLE	-	10 LA4
Serial No.	6613M/L	861-12/M1	7890815

B. Motors

Particulars	Motor # 1& 2	Motor 3 & 4	Motor 5
Make	NGEF	NGEF	Crompton Greaves
Amps	86	138	187
Voltage, V	440	415	440
rpm	1445	1445	1475
HP/kW	60/45	100/75	150/110
Insulation class	B	B	B

8.3 OBSERVATION, ANALYSIS AND FINDINGS

A. Pump Parameters

i The flow measurements were carried out and the parameters are given below:

Pump No.	Hs in m	Hd in m	Vel in m/s	Q in m3/h	Theoretical kW	% comb Eff.
1	4	22	3.37	402	19.73	51.80
2	4	22	3.89	402	22.67	57.13

ii The combined efficiency is satisfactory.

B. Electrical Parameters

i The measured electrical parameters are given below:

Pump No.	VL in volts	Current in amp	Rated kW	Actual kW	Power Factor	Hz	RPM (actual)	% loading
1	378.87	70.1	45	38.08	0.82	47.9	1394	84.62
2	375.41	71.3	45	39 68	0.82	47.9	1392	88.18

ii The operating power factor is good and loading is also found to be good.

iii Water seepage from the storage tank requires immediate attention since water logging is seen in the entire station area Cables routed on the floor are also drenched.

- iv Capacitors of capacity 2 XC25 kVAr and 2 X 15 kVAr are installed on the busbar for improvement of operating power factor of the motors.
- v Soft starters are installed for 60 hp motors.
- vi The 150 hp motor is lying idle and this could be shifted to any suitable pump house.
- vii The contract demand and the maximum demand of the station is well matched.

8.4 RECOMMENDATION

- i. The 150 hp should be shifted to a suitable pump house as it is lying idle.
- ii De-watering arrangement has to be done, since the cables are under water always.
- iii The water sleepage from the adjacent tank wall should be immediately repaired so that water seepage is stopped.

9.0 MOUNT JOY PUMP HOUSE - HANUMANTHANAGAR

9.1 FACILITY DESCRIPTION

The water is received from BTR in 16" dia pipe. This pump house feeds to ground level reservoir of 0.6 MG capacity with 24".

There are 3 pumps of 50HP capacity, out of which two are main & third is standby. Normally these pumps run for more than 14 hours.

9.2 EQUIPMENT DETAILS (3 x 50 HP)

A. PUMPS	B. MOTORS
Make : Kirloskar	KEC,
Type : MF 2530	Capacity : 37 kW/50HP
Head : 75 Ft.	Speed : 1450 rpm
GPM : 73000	Volt : 420
	Amps : 63
	Frame : TRQ
	Capacitor bank 2X15kVAr

9.3 OBSERVATION, ANALYSIS & FINDINGS

A. Pump Parameters

i The following table gives the details of flow measurements

Pump No.	Hs in m	Hd in m	Vel in m/s	Q in m3/h	Theoretical kW	Actual kW	% comb Eff.
2	2	20	2 46	292	14 33	27 86	51 43

The flow measurements on the other pumps was not carried out due to the non-availability of suitable location or free pipe.

ii. The combined efficiency of the existing pump No.2 is only 51.43% which can be further improved to 70% with replacement of pumps-motor sets. This measure will envisage energy savings of 42710 kWh/yr amounting to Rs. 85420/- year per set or motor. The investment required is Rs.1.5 lakhs

iii. Provision for measuring the suction head was not available but during discussion it was indicated that the suction head anywhere could be anywhere between 1.7 kg/cm^2 to 2.0 kg/cm^2. The incoming pressure may be measured by the Board by making suitable provision at the inlet, In case of sufficient head is available at the inlet, a Booster pump to raise the pressure to 2 kg/cm^2 house could be proposed.

B. Electrical Parameters

i. The following table gives the measured electrical parameters.

Pump No.	VL	IL Amp	Rated kW	Actual kW	pf	Hz	RPM	RPM Rated	% Loading
2	356.4	53.2	37	27.86	0.83	48.3	1427	1450	75.30
3	380 6	51 6	37	32.1	0 92	48.3	1422	1450	86.75

ii. The operating power factor and loading on motor is satisfactory.

iii. Replacement of the existing motor with an energy efficient motor is discussed under pump parameters.

9.4 RECOMMENDATIONS

i The incoming pressure at main inlet pipe and variations at all operating conditions has to be measured.

ii. Whether booster pump in place of existing pump could be installed has to be checked up.

Iii. On the other hand if inlet pressure is as, in case of other stations (say 2 mtrs) the existing pumping system may be replaced by high efficient pumps as energy saving device. The economics of replacement of existing pumps is detailed below:

	Each pump	For 3 pumps
Investment on new high efficient pumping set with 70% from 51.43%	: Rs. 1.5 lakhs	4.5 lakhs
Saving of energy In unit/annum	: 42,710	1.2 lakhs
Cost of energy saved per annum	: Rs 85,420/-	2.5 lakhs
Payback Period	< 2 years	< 2 years

9.5 SUMMARY OF POTENTIAL SAVINGS

Sl No	Measure	Annual Savings		Investment Required Rs (Lakhs)	Simple Payback Period Years
		Energy (lakh units)	Cost Rs (Lakhs)		
I	By replacing high efficient pumping set with 70% from 51.43	1.2	2 5	2.5	1

10.0 BASAVANGUDI (NEAR NATIONAL COLLEGE)

10.1 FACILITY DESCRIPTION

This is a booster pump house used in earlier years to fill the overhead tank when incoming pressure was not sufficient. It is learnt that presently these are not used. Both the pumps sets are also not in working.

10.2 EQUIPMENT DETAILS

There are 2 X 60HP (45kW) pumps. The description of pump and motor are as follows:

Motor 1 & 2		Booster Pump 1 & 2
Make	: Siemens	Kirloskar
Rating	: 60 HP (45 kW)	250 LPS
		12 mtrs head
pf	: 0.87	Year : 1975

10.3 OBSERVATIONS, ANALYSIS AND FINDINGS

A As these booster pumps are not presently utilised these could be shifted to other areas like Mount Joy/Hosahalli, if head, discharge and other parameters meet the requirements If one pump is required to be retained, second pump could be shifted taking into consideration of type of work invovlved.

B The cables, general maintenance of equipments, pump and motor is not up to the mark. Requires immediate attention.

RECOMMENDATIONS

In case the pumps are not required to be used at the present place , these could be shifted to other useful area of the network.

11.0 INDIRANAGAR OVERHEAD TANK STATION

11.1 FACILITY DESCRIPTION

This pump house receives water from Aero-engine Ground Level Reservoir by gravity. There are two pumps of 40 hp each, one is normally run and the other is standby. Presently one of the pump is not in working condition. Water is filled into overhead tank which is 20 m high.

11.2 EQUIPMENT DETAILS

A Pumps (2 X 40 HP)

Pump details are not available

B. Motors

Particulars	Motor # 1& 2
Make	Siemens
Frame	KL13
Voltage, V	440
rpm	1450
HP/kW	40/30
P F	0 86

11.3 OBSERVATION, ANALYSIS AND FINDINGS

A Pump Parameters

i The flow measurements were carried out and the parameters are given below·

Pump No.	Hs in m	Hd in m	Vel in m/s	Q in m3/h	Theoretical kW	% comb Eff
1	29	20	0.8	141	5.76	35.25*

* Due to inadequacy of availability of water, the valve of throttled by 50%.

ii The combined efficiency is quite low as the pump had been throttled due to insufficient water availability Considering the application replacement of the system is not suggested.

B. Electrical Parameters

i The measured electrical parameters are given below:

Pump No	Voltage in volts	Current in amp	Rated kW	Actual kW	Power Factor	Frequency in Hz	RPM (actual)	% Loading
1	408.3	32.4	30	16.35	0.7	48.1	1426 (1450)	54.4

ii The operating power factor is low but further improvement will not be beneficial to the BWSSB in view of LT metering for the installation.

11.4 RECOMMENDATIONS

NIL

12.0 KORMANGALA

12.1 FACILITY DESCRIPTION

This pump house receives water from Byrasandra leaky valve.

The pump operates twice in week for a very small period.

The pumps were not readily available for inspection. However considering the application no further investigations were made.

12.2 RECOMMENDATIONS

NIL

13.0 ULSOOR PUMP HOUSE

13.1 FACILITY DESCRIPTION

There are two pumps of 75 HP of which one normally runs and the other is a standby. The source of water is from Byrasandra Tank and partly from High Ground pumping station to this pump house The military area in and around Ulsoor is fed by this pump house.

13.2 EQUIPMENT DETAILS

A. Pumps (2 X 75 HP)

Particulars	Pump # 1 & 2
Pump make	Kirloskar
Discharge	84 lps
Head, m	42
Speed rpm	1475

B. Motors

Particulars	Motor # 1 & 2
Make	Siemens
Voltage, V	440
rpm	1490
Amps	96
HP/kW	75/55
P F.	0 87

13.3 OBSERVATION, ANALYSIS AND FINDINGS

A. *Pump Parameters*

i The measured pump parameters are as given below:

Pump No.	Hs in m	Hd in m	Vel m/s	Q m3/h	Theoretical kW	System Eff (%)
1	2	20	2 69	349	17.12	42.35

ii. The combined efficiency is only 42.35%, which is considerably low. The existing motor pump system can be replaced to give a combined efficiency of 70%. The energy savings that can be achieved is 35390 kWh/yr assuming 8 h/day for 365 days amounting to Rs. 70,780/- per year. The investment required is Rs. 1 5 lakhs and simple payback period is 2 years and 2 months.

B *Electrical Parameters*

i The measured electrical parameters are tabulated below:

Pump No	Rated kW	Actual kW	% Load	VL	IL	pf	RPM	Sl.No
1	55	40.4	73.53	403	67.9	0.8	1419 (1465)	52536

ii. The motor replacement can be done to achieve energy savings as given in the section of pump parameters

13.4 RECOMMENDATIONS

i The existing motor pump set should be replaced by a high efficiency motor pump set to get a combined efficiency of 70% as against the present 42.35% This measure will achieve energy savings to the tune of 35390 kWh/yr amounting to Rs. 70,780/- per year.

ii Annual Energy savings = 35390 kWh

iii Annual Cost savings = Rs. 70,780 /-

iv Cost of Implementation = Rs. 1.5 lakhs

v. Simple payback period = 2 years and 2 months

13.5 SUMMARY OF POTENTIAL SAVINGS

Sl. No	Measure	Annual Savings		Investment Required Rs. (Lakhs)	Simple Payback Period Years
		Energy kWh	Cost Rs		
i	Replacement of existing high efficiency motor pump set to get a comb. efficiency of (70%) as against the present 42 35% (2 no. Pump sets)	70780	141560	3.0	4 2

14.0 BANAPPA PARK

14.1 FACILITY DESCRIPTION

This station supplies to the area of covering Cauvery Bhavan. The pump is used to fill the overhead tank of 0.2 MGD at 30 m height.

14.2 OBSERVATION, ANALYSIS AND FINDINGS

A Pump Parameters

There are two pumps out of which one pump is not in working condition. Presently, there is no standby readily available.

B Electrical Parameters

The electrical parameters of the running pump have been measured and are tabulated below.

Pump No.	VL in volts	Current in amp	Rated kW	Actual kW	Power Factor	Hz	% loading
1	408.2	54.1	45	33 58	0.86	47 8	74 02

i The operating power factor and loading motors are satisfactory

ii Flow measurements were not possible in view of the inadequate pipe length available

iii The pumps are embedded below the ground level, closed with false flooring and there is no accessibility to the pumps.

14.3 RECOMMENDATIONS

i The location of the pump and motor which is presently concealed requires review, and sufficient ventilation should be made available

ii The non-working pump set should be immediately repaired and be made available for service whenever required.

15.0 DOMLUR

15.1 FACILITY DESCRIPTION

There is overhead tank of 2 MG at a height of 12 m. There is 8” dia pipeline from CLR. There is one no. of 50 HP motor which fills the overhead tank. It normally runs for one hour in a week.

15.2 EQUIPMENT DETAILS

A. Pump

Make	Capacity	Head	rpm	m/c no.
Krloskar	159 LPS	36 m	1421	2800819

B. Motor

HP/kW	Amps	pf	rpm
37/50	64	0.87	1470

15.3 OBSERVATION, ANALYSIS & FINDINGS

A Pump Parameters

The following table gives the flow measurements of the pump

H in m	H out m	Q m^3/h	Theoritical Power	Actual Power kW	Q m^3/h	Combined Efficiency
2.0	20	361	9 84	29 97	361	32.73

The operating hours of the pump is very limited. Thus existing pump could be continued to be utilised.

B Electrical Parameters

The measured electrical parameters is tabulated below:

V	I	Rated kW	kW	pf	% load
370	54	37	29.97	0.86	81.0

ii The operating power factor and the load on the motor is found satisfactory.

15.4 RECOMMENDATION:

In case any surplus pump with higher efficiency is available at a later date, the existing pump may be replaced without any extra cost to the Board.

16.0 HAL AERO-ENGINE - I

16.1 FACILITY DESCRIPTION

There are two pumps of 90 hp one is main and the other standby. This station receives water from HGR to the tank of 5 MG capacity and another similar tank is also under construction. This pump house feeds Indiranagar, HAL, NGEF, Jeevanbhimanagar. Normally the water tank of 5 MG fills up in two days time.

16.2 EQUIPMENT DETAILS

A Pumps

Particulars	Pump # 1 & 2
Pump make	Beacon
Discharge	161.8 lps
Head, /m	24 4
Speed rpm	1450
Type	10LA1
Input kW	53.7
Serial No.	8191633BCR409

B. Motors (2 x 90 HP)

Particulars	Motor # 1 & 2
Make	Crompton
Frame	02505
Voltage, V	415
rpm	1475

Particulars	Motor # 1 & 2
Amps	126
HP/kW	90/67
P.F.	0.84
Serial No.	BCR409
Remarks	Capacitor bank is available

16.3 OBSERVATION, ANALYSIS AND FINDINGS

A. Pump Parameters

i The flow measurements were not carried out due to the non-availability of free length of pipe line.

B. Electrical Parameters

i The measured electrical parameters are given below

Pump	Voltage	Current	Rated	Actual	Power	Frequency	RPM
1	356 4	120	67	62 4	0.84	48.1	1420
2	354 7	118 9	67	62.1	0.83	48 1	1420

ii The operating power factor is good and the loading is also good. The KEB billing is on LT and hence any further improvement in power factor is not beneficial to the board.

16.4 RECOMMEDATIONS

NIL

17.0 OMBR (Old Madras Banaswadi Road) PUMP HOUSE

17.1 FACILITY DESCRIPTION

This pumping station receives water from High Ground Pump House. The capacity of the storage tank is 2 MG. There are 4 no. of pump of capacity 100 HP each which feed to HRBR II Block. One pump is in operation presently and it meets the requirements of the area. The pump operates for 3 - 4 hours per day. As and when the new areas are added in the distributory other pumps are proposed to be used.

17.2 EQUIPMENT DETAIL *(4 X 100 HP)*

A. Pump

Particulars	Pump 1 to 4
Make	Kirloskar
Discharge lps	275
Head m	30
Hydraulic kW	71.89
Speed rpm	1465
Type	100 PH 2
Serial No	1704291016

B. Motor

Particulars	Motor 1 to 4
Capacity kW	75
Voltage	415
Current	133
Speed rpm	1465
Serial No	91 spc 33-01
Make	Kirloskar

17.3 OBSERVATION, ANALYSIS AND FINDINGS

A. Pump Parameters

i. Pumping station is comparatively new and is designed well for control panel arrangements, distribution system, cabling routing, spacing and piping arrangements.

Ii The flow measurements are tabulated below:

Pump	Hs in m	Hd in m	Vel in m/s	Q in m3/h	Th kW	Actual kW	Comb Eff.
1	2	22	4.8	857	46.72	72.8	64.18

iii. The combined efficiency is found to be 64.18% which is satisfactory.

B Electrical Parameters

I The following table gives the measured electrical parameters:

Pump	Volt	I Amp	Rated kW	Actual kW	Pf	Hz	RPM	% Loading
1	389.25	121.6	75	72.8	0.86	47 8	1400	97.07

ii. Capacitors bank of 30 kVAr are connected across the terminal of the motor which comes into operation after the start-up of the motor which is a good practice.

iii. The operating power factor is 0.83 which is satisfactory There is scope for further improving the operating power factor of the bus to 0 92 .

iv. The monthly billing power factor as recorded by the KEB is 0.56 whereas the operating power factor of motors is not less than 0.85. Penalty has been paid for low power factor. The typical penalty paid for the month of Nov 96 for 4968 units at the rate of Re.0.29 per unit was Rs.1440/-.This requires immediate attention and corrective action such as calibration of meter.

v. The maximum demand for billing purpose was 188 kVA based on 75% of the contract demand of 250 kVA. The actual maximum demand is in the range of 100 - 115 kVA. The contracted demand could be reduced by 90 kVA (i.e. to 165 kVA) which will amount to saving in demand charges by Rs.1.02 lakh per year.

vi. The motor is well-matched with the pump.

17.4 RECOMMENDATIONS

A. Improvement of Power Factor at the Bus

The power factor of the bus can be improved to 0.9 from 0.86 by installing capacitor of 15 kVAr. The kVA demand savings is 3 kVA which amounts to Rs.300 per month or Rs.3600/- per year with an investment of Rs.900/- and simple pay back period is 3 months.

B. Reduction of Contracted Demand

The present contracted demand of 250 kVA should be reduced to 165 kVA which will meet the present requirements thereby saving demand charges of 85 kVA p m., Rs 1.02 lakh per year with no investment involved. If higher demand is required at a later date, KEB could be approached for the same.

7.5 SUMMARY OF POTENTIAL SAVINGS

Sl. No	Measure	Energy savings		Investment reqd. Rs.	Simple payback period (months)
		Demand	Cost Rs.lakh/y		
io	Improvement of pf at bus	3 kVA	0.04	900	3
ii	Surrendering of excess kVA demand	80 kVA/p.m	1.02	NIL	Immediate
Total		85 kVA	1.06	900	-

18.0 I T I PUMP HOUSE

18.1 FACILITY DESCRIPTION

This pumping station receives water from High Ground Pump House. There are two storage tanks of capacity 0.8 MG each. One tank caters to the need of J B Nagar, M S Nagar and Muniga Layout while the other caters to Charles Campbell Road and J C Road.

There are 2 number of pumps of capacity 50 HP out of which one is a standby. Only one pump is in operation presently as it meets the requirements of the area. The pumps are operated for 3 - 4 hours per day.

18.2 EQUIPMENT DETAILS (2 x 50 HP)

A. Motor

Particulars	Motor 1 &2
Capacity kW	37
Volts	415
Current - Amps	67
Speed rpm	1460
Serial No	LB050920
Make	Siemens

B. Pump

Particulars	Pump 1 & 2
Make	Best & Crompton
Discharge lps	69
Head m	31.4
Hydraulic kW	21.2
Speed rpm	1450
Serial No.	LB050920

18.3 OBSERVATION, ANALYSIS & FINDINGS

A. Pump Parameters

I The flow measurements are tabulated below:

Pump	Hs in m	Hd in m	Vel in m/s	Q in m3/h	Th kW	Actual kW	Comb Eff.
2	5	20	1.74	224	9.16	32.3	28.36

ii The combined efficiency is 28.3% which is very low. The existing pump can be replaced by new pump of high efficiency. This measure will give an annual energy saving of 65700 kWh/year amounting to Rs:75,555/-. The investment cost is Rs.1.5 lakh per pump-motor the simple payback period works out to be less than 2 years.

For two pumps, investment cost is Rs.3 0 lakhs and savings of Rs.1 5 lakh.

B. Electrical Parameters

i The following table gives the measured electrical parameters·

Pump	V in volt	I In Amp	Rated kW	Actual kW	Pf	Hz	RPM	% Loading
1	346	65.9	37	31.38	0.83	47 8	1406	84.8
2	346	63.4	37	32.3	0 84	47.9	1406	87 3

iii The motor is properly matched with the pump.

iv The operating power factor and the loading on the motor are satisfactory.

18.4 RECOMMENDATION

A. Replacement of existing inefficient pumps by new high efficiency pump-motor set

The existing pumps should be replaced by new high efficiency pump-motor set which will give an annual energy saving of 65,700 kWh amounting to Rs.75,555/-. The investment required is Rs.70,000/- and simple payback period is 1 year.

18.4 SUMMARY OF POTENTIAL SAVINGS

Measure	Energy savings		Investment reqd.	Simple payback period
	kWh/y	Cost Rs./y	Rs.lakh	year
Replacing existing inefficient pumps by high efficiency pumps	1.31	1.51	3.0	2.0

19.0 CHIKKALALBAUGH PUMP HOUSE

19.1 FACILITY DESCRIPTION

There are two pumps of capacity 50 HP each with main and standby configuration. These pumps are used once in a week to fill up the overhead tank and feed to the areas around chikkalalbaugh in case of emergency only. There is a small intake tank and for filling up of overhead tank intermediately running of these pumps.

19.2 OBSERVATION, ANALYSIS AND FINDINGS

These pumps are used only for intermediate service further analysis for efficiency is not considered necessary as there is no scope for energy conservation.

The operating hours of the pumps is very limited and as such one pump is sufficient to take care of the requirements. The standby pump could be diverted to any other suitable installation.

19.3 RECOMMENDATION

The standby pump of 50 HP should be shifted to suitable installation (old or new) thereby avoiding new investment.

20.0 JAYANAGAR - MARKET COMPLEX

20.1 FACILITY DESCRIPTION

This station supplies to the area of Jayanagar. There are two pumps The smaller pump is of 50HP capacity as against 100 HP for big pump. (There is no name plate for bigger pump , but estimated).

20.2 EQUIPMENT DETAILS

A. Pump

No name plate available.

B. Motor

1 50 HP/37 kW
2. 100 HP

20.3 OBSERVATION, ANALYSIS AND FINDINGS

Pump Parameters

i Flow measurement was not possible in view of inadequacy of free pipe length
ii Out of two pumps, 100 HP pump runs for 4 hours alternate day and 50 HP for a period of 2 hours
iii The outgoing discharge of pump is maintained at 2.5 kg/m^2.

Electrical Measurement

i The following table gives the measured electrical parameters:

Motor	V	I	pf	kW	Rated kW	Hz	% Loading
I	406	97	0.81	64.5	75	49.2	86.0

ii The operating power factor and the loading on the motor is satisfactory.

iii Change in start up panel is necessary

20.4 RECOMMENDATION

None

21.0 JOHNSON MARKET (CLR)

21.1 FACILITY DESCRIPTION

There are two pumping stations. Water is received from Byrasandra and supplies to M G Road, Brigade Road, Military areas etc The present trend of running of pumps are 2 A.M to 8 00 A M (6 hours) and another pump hours 8.00 A.M to 4 00 P.M (8 hours). There are 12 X 3 MG capacity storage tanks the pumps also run for more number of hours if water level is good.

21.2 EQUIPMENT DETAILS

Pump House No. I (ISRO)

Pump	I	II
	Kirloskar	Kirloskar
Type	8UP-m 750	BUP2-m 15
Head	25m	33 5m
Discharge	159 LPS	160 LPS
Hydraulic kW	59	64
rpm	1450	1450
Sl.No	-	8283007

Motor	Make	V	I	kW	rpm	Hz	Insulation	m/c. no
1 & 2	KEC	415	125	75	1460	50	Class-B	2800810-16

Capacitor banks are 8/10 kVAr

Pump House No. 2 (CLR)

Pump	I
Make	Kirloskar
Type	8UP-m 150
Head	33.5m
Discharge	160 LPS
Hydraulic kW	64
rpm	1450
Sl.No	8283007

Motor	Make	V	I	kW		Hz	Insulation	M/c. no.
1	KEC	415	125	75	1460	50	Class-B	2800810-16

21.3 OBSERVATION, ANALYSIS & FINDINGS

A. Pump Parameters

I The flow measurements are given below.

Pump House 1

Pump No.	Actual kW	Hs in m	Hd in m	Q m^3/h	Theoretical kW	% Combined Efficiency
I	52 42	7	20	927	32 85	62.7
II	69 6	7	20	987	35 08	50.4

ii The flow is satisfactory

B. Electrical Parameters

I The following table gives the measured electrical parameters

Pump No	V	I	pf	kW	Rated kW	Freq.	% Loading
I	368	95	0.83	52.42	75	50	70 0
II	368	119	0.90	69.6	75	50	92.66

ii The loading and the operating power factor of the motor is satisfactory.

21.4 RECOMMENDATION

None

22.0 MALLESHWARAM CJF

22.1 FACILITY DESCRIPTION

The water to MALLESWARAM is received from High Ground Station 1 & 2 , LLR and Thippagondanahalli. There are six tanks whose details are given below:

Tank No	Capacity MG
1	3.5
2	3 6
3	3 5
4	3.5 (not in service due to fall of retaining wall)
5	9.0
6	14.0

The areas which are fed from this station are BEL, Indian Institute of Science, Local office, HGR , KGT, Peenya and Malleswaram by dedicated 6 different pumping station The following paragraphs furnishes details of pumps operating for Malleswaram area Other stations are covered by separate chapters.

22.2 EQUIPMENT DETAILS

A Pumps

Pump No	1 to 3	4	5	6 & 7
Make	Worthington Simson Ltd	Mather + Platt	Worthington Simson Ltd	Pulsometer
Discharge gpm	2785/3000	2785	1380	1400
Head	125 feet	100 feet	90/100 feet	100 feet
RPM	1460	1460	1450	1460
Fed from Tank No	1 to 3	4	-	-
Remarks	Feeds to Malleswaram, Guttahalli Peenya and other adjoining areas Pump No.1 is not working.			

B Motors

Motor No	1 to 4	5	6 & 7
Capacity	150 HP	85 Hp	60 HP
Make	Metro-politan Vickers	Lawrence Scott Electric Motor	Metro-politan Vickers
Voltage		400V	400/440 V
Current	182 A	110 A	75 A
Speed rpm	1460	1485	1475
Frame size	RL8930		
Year	1937	1957	
Remarks	Unit 1 not working		

Unit 2 has starter problem

22.3 OBSERVATION, ANALYSIS AND FINDINGS

A Pump Parameters

I The flow measurements of the pumps are given below

Pump No	Actual kW	Hs In m	Hd in m	Q m^3/h	Theoretical kW	% Comb Effi.
3	110 47	1	15	708	26.83	24.28
4	Flow measurements not possible					

ii Out of the 7 no. of pumps installed, two are not working due to motor burning/starter problems iii The pumps are very old of 1937/1957 and the designed efficiency of these pumps are very low as compared to the high efficiency of pumps presently available in the market. The combined efficiency that can be achieved is up to a minimum of 70% as against 25%.

iv The piping done for this station is based on earlier requirement of the city distribution. As a part of expansion additional pump houses have also been commissioned.

V There are six tanks of total capacity of 37 MG is available in the premises which can be optimally utilised if interconnecting piping network is also established. At present dedicated tanks with their dedicated pump houses are used to supply water to different localities, whereas higher flexibility can be obtained if incoming and outgoing networks are made between tanks and pump houses.The number of pumps can also be optimised so that operating hours could be increased. Thus demand/water management could be optimised. However, this requires a study team of BWSSB to go into various aspects.

vi From the present operating practice of the pumps 1 to 7 of CJF the head requirement is 50 feet whereas the name plate readings of the pump are rated for 125 feet/100 feet. This requires a review of head and capacity with respect to each area as this accounts for wastage of energy The existing pumps should be re-rated by lower head with higher discharge pumps to suit the present day requirements. The hydraulic rating of the new pumps will come down to suit the exact requirements.

B Electrical Parameters

i The following table gives the measured electrical parameters

Pump No.	V	I	pf	kW	Rated kW	Freq.	% Loading
3	430 5	157.2	0.94	110 47	110	47.8	100.43
4	394.4	117	0.92	73 3	110	47 8	66 6

ii The operating power factor of the motors is found to be satisfactory.

iii The contract demand is 550 kVA and energy consumption details of Malleswaram is given below:

Month	Recorded kVA	Energy kWh	Power Factor	Rs. Lakh
Feb 96	534	97320	(-).06	1.76
Mar	486	116940	(-) 07	2.00
Apr	528	121500	(-).04	2.09
May	528	141600	-	2.37
Jun	570	145380	0 95	2.37
Jul	540	160140	(-) 07	3 66
Aug	720	152700	(-) 06	3 86
Sep	534	169080	(-).03	4.08
Oct	534	174840	(-).04	4 20
Nov	570	149880	(-).03	3.73
Dec	570	161040	(-) 01	3 97
Jan 97	528	169800	(-) 02	4.09
Feb	546	150540	1.00	3.70

(-) Leading

22.4 RECOMMENDATION

i. The existing motor pump sets of 1937/1957 vintages should be replaced with the presently available high efficient motor pump sets to have combined efficiency of 75% as against 25% at present. The energy savings envisaged (operating hours =.1200 in a year) by implementing this measure is given below:

Parameters	150 HP	100 HP
Energy Savings	3.19 lakh kWh	2 39 lakh kWh
Cost Saving	Rs.6.38 lakh	Rs.4.78 lakh
Cost of Implementation	Rs.2.00 lakh	Rs.2.00 lakh
Simple Payback Period	4 months	5 months
Total pumps to be replaced	3 Nos.	4 Nos.

Total energy savings that could be achieved with the replacement of 7 no. of pumps:

Energy Savings	=	19.13 lakh kWh
Cost Savings	=	Rs.38.26 lakh
Cost of Implementation	=	Rs.14 0 lakh
Simple Payback Period	=	5 months

ii Creating more flexibility between storage tanks and pump houses, Board should examine to have a common ring main between tanks/inlet to pump house and also common outlet rings, so that no. of pumps could be optimised in the entire Malleswaram zone

22.5 SUMMARY OF POTENTIAL SAVINGS

Sl. No	Measure	Annual Savings		Investment Required Rs. (Lakhs)	Simple Payback Period Months
		Energy lakh kWh	Cost Rs. (Lakhs)		
I	Replacing the existing motor pump sets with the presently available high efficient motor pump sets	19.13	38.26	14.0	5
2	Creating maximum flexibility between tanks and pump houses and also optimisation of the existing pump units	Savings cannot be quantified			

23.0 INDIAN INSTITUTE OF SCIENCE (Malleswaram)

23.1 FACILITY DESCRIPTION

This pump house receives water from CJF, Malleshwaram and feeds Indian Institute of Science. There are two pumps of 50 HP one main and the other standby.

23.2 EQUIPMENT DETAILS: (2 x 50 HP)

A. Pumps 1 & 2

Capacity	50 HP
Make	Beacon
Discharge	755 lps

B Motors 1 & 2

Capacity	50 HP
Make	Kirloskar
Voltage	415 V
Current	66 A
Serial No	90MOE22 - 17

23.3 OBSERVATIONS, ANALYSIS & FINDINGS

A Pump Parameters

The flow measurements were not possible due to the non-availibility of suitable free length of pipeline.

B Electrical Parameters

The measured electrical parameters are tabulated below

Pump No.	V	I	pf	kW	Rated kW	Freq.	% Loading
1	386	45 7	0.86	26.45	37	47.7	71 5

ii The operating power factor and loading on the motor is satisfactory.

23.4 RECOMMENDATIONS

None

24.0 BEL PUMP HOUSE (Malleswaram)

24.1 FACILITY DESCRIPTION

This pump house receives water from CJF, Malleswaram pumping station and supplies to BEL colony. The pump is run for 12 hours on alternate days.

24.2 EQUIPMENT DETAILS (2 x 50 HP)

A Pumps 1&2

Capacity	50 HP
Make	Beacon
Discharge	100 lps
Head	30 m

B Motors 1 & 2

Capacity	37 kW/50 hp
Make	Kirloskar
Voltage	415 V
Current	65 A
Frame	LG200M
Serial No.	90SH396 - 164
Speed in rpm	1460
Insulation Class	B

24.3 OBSERVATION, ANALYSIS AND FINDINGS

A Pump Parameters

I The flow measurement details have been tabulated below:

Pump No.	Total Head m	Water flow in m^3/s	Hydraulic kW required	Actual kW drawn	System Efficiency
50 HP	18	0.083	14.7	26.31	55.8%

The system efficiency is found to be satisfactory.

B Electrical Parameters

i The electrical parameters measured have been tabulated below:

Pump No.	V	I	pf	kW	Rated kW	Freq.	% Loading
1	373.68	47.9	0.82	26.31	37	47.8	71.1

II The operating power factor is low and it could be improved to 0.9 with the installation of capacitor of capacity 6 kVAr. The demand savings that is envisaged with this measure is 3 kVA/month and distribution losses of 117 kWh/year amounting to Rs.3500/-

24.4 RECOMMENDATION

The existing operating power factor of the pump is 0.82 and should be improved to 0.9 with installation of capacitor of capacity 6 kVAr costing Rs 1800/- The demand savings envisaged with this measure is 3 kVA/month amounting to Rs 3000/-

OLD MACHALIBETTA STATION (Old Name) Yelahanka at Malleswaram (3 x 100 HP)

A Pump - III

Type	8 DP LM 15
No.	8280034
D/A No.	86/93/4143/80
Head	36 mtrs
Discharge	140 ltrs/sec
rpm	1450 rpm

B Motor III

Make	HP/kW	Amps	Frame	Remarks
Kirloskar	100/75	125	LC-25008	2 X 25 kVAr capacitor banks available

25.3 OBSERVATION, ANALYSIS & FINDINGS

A Pump Parameters

I The flow measurements of the pumps are given below:

Pump No	Actual kW	Hs In m	Hd in m	Q m^3/h	Theoretical kW	% Comb Eff.
2	44.77	2	22	631	34.4	76.84
3	57.46	2	22	544	29.66	51.62

Old Machalibetta

Pump No.	Actual kW	Hs In m	Hd in m	Q m^3/h	Theoretical kW	% Combined Efficiency
1	25.89	6	22	381	16.62	64.19

II The combined efficiency are found to be satisfactory

B *Electrical Parameters*

i. The measured electrical parameters are tabulated below:

Yelahanka

Pump No.	V	I	pf	kW	Rated kW	Freq.	% Loading
1	403 09	74	0.83	44.77	75	48.1	59 7
2	401.36	40.4	0.93	57.46	75	48	76 61

Old Machalibetta

Pump No	V	I	pf	kW	Rated kW	Freq	% Loading
1	399 63	40.4	0.93	25 89	75	48	34.5

ii. The pf in one of the panel is 0.93 which is satisfactory whereas in another panel the same is 0.83, requiring improvement in pf.

iii. 3 nos. of non-working pumps requires immediate repairs.

iv. Large unbalanced currents (more than 10%) in phases indicating that motor is rewound.

v The contract demand of this station is 200 kVA and the following table gives the electricity consumption for the past one year.

Month	Recorded kVA	Energy lakh unit	Power Factor	Rs. Lakh
Feb 96	160	0.29	0 92	0.53
Mar 96	160	0.31	0 94	0.56
Apr 96	174	0.31	0.90	0.57
May 96	168	0.33	0.84	0.60
Jun 96	162	0 33	0.93	0.59
Jul 96	160	0.33	0.94	0.80
Aug 96	158	0.32	0.94	0.75
Sep 96	158	0.32	0.82	0 85
Oct 96	160	0.39	0.96	0.99
Nov 96	170	0.44	0.89	1.1
Dec 96	166	0.42	0.85	1 05
Jan 97	188	0 39	0 85	1 02
Feb 97	188	0.39	0.85	1.0

25.4 RECOMMENDATION

The existing operating power factor of old machalibetta pump at yelahanka is 0.83 and should be improved to 0 9 with installation of capacitor of capacity 8 kVAr costing Rs.2400/-. The demand savings envisaged with this measure is 4 kVA/month amounting to Rs 4800/-.

Demand Saving	= 4 kVA/month
Cost Saving	= Rs 4800/-
Cost of Implementation	= Rs 2400/-
Simple Payback period	= 6 months

25.5 SUMMARY OF POTENTIAL SAVINGS

Sl No	Measure	Annual Savings		Investment Required Rs.	Simple Payback Period Months
		Energy lakh kWh	Cost Rs.		
I	To improve the existing operating power factor by installing capacitor of 8kVAr	4kVA/month	4800	2400	6

26.0 MALLESWARAM OFFICE COMPLEX

26.1 FACILITY DESCRIPTION

There is a exclusive pump-motor set of 1 X 25 HP for filling up of Malleswaram Complexes. The running of the pump is intemittent depending upon the requirement of the BWSSB Complex at Malleswaram

26.2 EQUIPMENT DETAIL (1 x 125 HP)

A Pump

Details of Pumps not available

B Motor

Make	Kirloskar
Capacity HP/kW	25/18
Speed in rpm	1450
Current in Amp	32.5

26.3 OBSERVATION, ANALYSIS & FINDINGS

A Pump Parameters

I The flow measurements were not possible due to the non-availability of suitable free length of pipeline.

II Considering the type of duty for the pump further analysis is not made

B Electrical Parameters

i The measured electrical parameters are tabulated below

Pump No.	V	I	pf	kW	Rated kW	Freq.	% Loading
1	379	33.5	0.85	17.56	18	48	97.5

ii The operating power factor of the motor and the loading on the motor is found satisfactory.

iii There is one more pump in the complex of capacity 170 HP which is not in working condition for the last five years. The Board may take further action either to dispose off or replace the same as the case may be.

26.4 RECOMMENDATION

None

27.0 HGR & KGT PUMP HOUSE (MALLESWARAM)

27.1 FACILITY DESCRIPTION

There are 4 pumps two dedicated to HGR and other two are for KGT. These pumping stations receive water from Highground Water Pump to the storage reservoirs. Normally one of the pumps operate the other being standby. The pressure required to feed KGT is 22 lb/in^2 as against 6lb/in^2 for HGR

27.2 EQUIPMENT DETAILS

A Pumps

Particulars	Pump # 1 & # 2 (HGR)	Pump # 3 & # 4 (KGT)
Pump make	Kirloskar Brothers	Mather + Platt
Discharge	530 lps	1450 m^3/h
Head, m	13.8	17
Speed rpm	980	1480

B Motors

Particulars	Motor # 1 & #2	Motor # 3 & # 4
Make	Crompton	NGEF
Year	1975	
rpm	980	1460
Amps	200	208
HP/kW	150/110	150/110
Serial No	KDH0065/75	17417204

27.3 OBSERVATION, ANALYSIS & FINDINGS

A Pump Parameters

The flow measurement from individual pumps is not possible in view of non availability of pipe line However manifold measurements have been taken and is tabulated below:

Manifold	Actual kW	Hs In m	Hd in m	Q m^3/h	Theoretical kW	% Combined Efficiency
1	161.6	1	15	2931	111.86	69.22

27.5 SUMMARY OF POTENTIAL SAVINGS

Sl No	Measure	Annual Savings		Investment Required	Simple Payback Period
		Energy	Cost Rs.	Rs.	Months
i	To improve the existing operating power factor by installing capacitor of 8kVAr	4 kVA/ month 247 kWh/yr	5300	2400	5

28.0 JAYANAGAR - T BLOCK

28.1 FACILITY DESCRIPTION

This station supplies to the area of ninth block, T Block and Tilaknagar. There are two pumps of capacity 1 x 50 HP and another of 1 x 25 HP. These pumps feed the overhead tank whenever required and normally directly to the distributory network.

28.2 EQUIPMENT DETAILS (1 X 50 HP) + (1 X 25 HP)

A Pumps

Particulars	Pump # 1	Pump # 2
Pump make	Details not available	
Discharge		1550 lps
Head m		22.7
Speed rpm		1440

B Motors

Particulars	Motor # 1	Motor # 2
Make	Kirloskar	-
Type	TQ1	-
Insulation class	B	-
Voltage, V	420	420
rpm	1450	-
Amp		31.4
HP/kW	50/37	25/18.5

28.3 OBSERVATION, ANALYSIS AND FINDINGS

A Pump Parameters

i Flow measurement was not possible in view of inadequacy of free pipe length

B Electrical Parameters

The electrical parameters of the motor is tabulated below

Motor	V	I	pf	kW	Rated kW	Hz	% Loading
I	391	25.3	0.71	13.35	18.5	49.2	73.0

ii The loading on the motor is satisfactory

iii Considering the type of application further analysis is not necessary.

28.4 RECOMMENDATIONS

None